Journal of Athletic Training 2006;41(1):109–116

www.journalofathletictraining.org

original research

Stylistic Learning Differences Between Undergraduate Athletic Training Students and Educators: Gregorc Mind Styles

Trenton E. Gould*; Shane V. Caswell†

*The University of Southern Mississippi, Hattiesburg, MS; †George Mason University, Manassas, VA

Trenton E. Gould, PhD, ATC, contributed to conception and design; acquisition and analysis and interpretation of the data; and drafting, critical revision, and final approval of the article. Shane V. Caswell, PhD, ATC, contributed to analysis and interpretation of the data and drafting, critical revision, and final approval of the article.

Address correspondence to Trenton E. Gould, PhD, ATC, School of Human Performance and Recreation, The University of Southern Mississippi, 118 College Drive, #5142, Hattiesburg, MS 39406. Address e-mail to trent.gould@usm.edu.

Context: Learning theory and pedagogic research are unfamiliar to many educators trained in the sciences. Athletic training educators must learn to appreciate the theoretic and practical value of pedagogic research, including learning styles.

Objective: To extend the learning styles research in athletic training by introducing the Mind Styles model and Gregorc Style Delineator instrument to investigate students' and program directors' baseline style preferences and to study the effects of sex, education level, and academic role on mean composite Gregorc Style Delineator scores.

Design: Correlational research design.

Setting: Instruments were mailed to program directors and administered in classroom settings.

Patients or Other Participants: Ten of 10 athletic training programs accredited by the Commission on Accreditation of Allied Health Education Programs formed sample 1, with 200 undergraduate athletic training students (68 men, 132 women, age $= 20.12 \pm 2.02$ years). A total of 43 program directors (22 men, 21 women, age $= 40.05 \pm 9.30$ years) created sample 2.

Main Outcome Measure(s): We used the Gregorc Style Delineator to measure participants' perceptual and ordering abilities, combining them in a quaternary design to create mean composite scores for the Concrete Sequential (CS), Abstract Sequential (AS), Abstract Random (AR), and Concrete Random (CR) Mind Styles subscales. We also noted each subject's sex, education level, and academic role.

Results: We obtained a response rate of 100% of undergraduates and 43% of program directors. The CS style was preferred by 44.5% ($n = 89$) of students and 58.1% ($n = 25$) of program directors. Program directors preferred the CS style more ($P < .001$) and the AS and AR styles less ($P < .001$) than predicted by χ^2 testing. Students preferred the CS style more ($P < .001$) and the AS style less ($P < .001$) than expected also. Men students preferred the AS style more ($P < .01$) and the AR style less ($P < .01$) than women students. Students by χ^2 testing were also less likely to prefer the CS style ($P < .01$) and more likely to prefer the AR style ($P < .001$) than program directors. No significant main effect was noted for education level ($P = .310$) or the interaction ($P = .108$).

Conclusions: Our findings add 2 unique elements to the athletic training literature by extending the investigation of styles to an original model (Mind Styles) and the effect of academic role on style. Program directors should strongly consider sex and academic role style differences when designing and implementing pedagogic methods.

Key Words: learning styles, cognitive styles, cognitive psychology, educational psychology, athletic training education

Athletic training professionals have embraced the value and necessity of scientific research to support evidence-based clinical practices. Similarly, athletic training educators must also recognize and value the necessity for rigorous scientific inquiry that examines learning theory and pedagogy to support evidence-based educational practices. However, many educators trained in the sciences possess little expertise or experience in learning theory and pedagogic research.[1] Thus, a potential disconnect between the discovery and sharing of knowledge is created. Therefore, it is essential that all athletic training educators appreciate the theoretic and practical value of pedagogic research, including learning styles.

Historically, the effectiveness of learning styles research has been much debated. Several arguments question the efficacy of learning styles research, with many citing a lack of a singular definition of the construct.[2] Sternberg[3] has provided some clarity by suggesting that there is really just ''style'' (primary construct) and that the secondary constructs deal with the different types of style (eg, cognitive, learning, teaching, thinking, etc). For the purpose of clarity, we will refer to the body of literature (ie, cognitive and learning style literature) as the styles literature for the remainder of this article. Conceptually defined, *style* is a general term encompassing all scholarship related to recognizing individual learning differences.[4] We chose to investigate these stylistic differences using the Gregorc Style Delineator (GSD), based on a theory posited by Gregorc[5] known as Mind Styles. The GSD focuses on the cognitive abilities of perception and ordering. Arranged via a quaternary design, the GSD sums the rank order of 10 sets of 4 words, thereby creating the Concrete Sequential (CS), Abstract Sequential (AS), Abstract Random (AR), and Concrete

Random (CR) mind styles. The CS individual prefers physical, hands-on tasks that are structured (eg, repair technician).[4,6] The AS individual prefers reflective thinking tasks that provide an expression of intellect and rationality (eg, academician).[4,6] The AR individual prefers nonphysical tasks that allow emotional and interpretive expression (eg, poetic writer).[4,6] The CR individual prefers investigative tasks that incorporate risk taking or multiple options (eg, cinematographer).[4,6]

Educational reform in athletic training has focused primarily on improving curricular content and formal outcomes via formative and summative assessment rather than the advancement of discipline-specific pedagogic theory. In the allied health literature there are investigations of students' stylistic differences in the professions of occupational therapy,[7–9] physical therapy,[10,11] dentistry,[12] nursing,[13–16] and athletic training.[17–22] These authors used several different style inventories, including the Kolb Learning Style Inventory,[8–10,14,16,18,19,21,22] the Preferred Environmental Preference Survey,[17,21] the Gregorc Style Delineator Research Edition,[11–13] the Group Embedded Figures Test,[15] the Babich and Randol Learning Style Inventory,[20] and the Rezler Learning Style Inventory.[7] The athletic training investigators used nonexperimental, correlational designs to observe relationships between styles and student characteristics such as sex,[17] education level,[17] admission success,[19] certification examination performance,[20] geographic region,[21] and consistency between classroom and clinic performance.[18,22] However, to date, no researchers in athletic training have corroborated the effects of these variables or extended the investigation of styles to include program directors, other style models (eg, thinking, mind, etc), or other style instruments. Turocy[23] further supported this claim by noting, ''Future research in this area [styles] also could include more investigations of this learning style [Preferred Environmental Preference Survey] and of learning styles based on other paradigms.'' Therefore, the threefold purpose of our study was to introduce an original styles model (ie, Mind Styles) and instrument (ie, GSD) to (1) investigate students' and program directors' baseline style preferences, (2) describe the relationship among sex, education level, and mean composite Mind Style scores, and (3) to assess the relationship between academic role (ie, student and program director) and mean composite Mind Style scores.

METHODS

Sampling and Participants

Our sampling frame consisted of a list of all Commission on Accreditation of Allied Health Education Programs (CAAHEP)-accredited undergraduate athletic training education programs at the time of this administration. However, no adequate list of undergraduate athletic training students was available. Therefore, we chose multistage cluster sampling because it provided a feasible sampling solution given our available list of CAAHEP-accredited institutions by allowing us to randomly sample clusters (ie, CAAHEP-accredited programs). Kalton[24] reported that if clusters are selected randomly, then the elements within the clusters (ie, students) are similarly selected in a random method. We performed an a priori power analysis to determine the sample size we needed to obtain a medium effect size. Setting α at .05, effect size at .64, and power at .8, we consulted Stevens'[25] tables, which suggested approximately 50 subjects per cell were required with 4 dependent variables. Therefore, 200 undergraduate students and 50 program directors were needed to satisfy our requirements.

Stage I consisted of a simple random sample of all CAAHEP-accredited athletic training programs (165 at the time of this study). A numeric code was assigned to each CAAHEP-accredited program. Program codes were then entered into SPSS software (version 11.0; SPSS Inc, Chicago, IL), and a computer-generated, random sample of 20 CAAHEP programs was selected. To achieve the a priori determined sample size of 200 undergraduate athletic training students, stage II consisted of our contacting the program director from the first school on our list of 20 programs. If the program director agreed to participate, we collected information on the number of students formally enrolled in that program. We continued this process of contacting program directors, confirming participation and gathering student enrollment figures until the undergraduate students (sample 1) totaled 200 in 10 CAAHEP-accredited programs. Stage III consisted of a separate, simple random sample of directors at all CAAHEP-accredited programs. Stage III methods were identical to stage I, minus the removal of the 10 CAAHEP-accredited programs from the population in sample 1. A computer-generated, random sample of 100 CAAHEP-accredited programs was selected. We chose 100 CAAHEP-accredited programs because a review of published athletic training research[17–22] suggested that we should expect less than a 50% response rate for program directors. Therefore, we intentionally oversampled, randomly selecting 100 directors of CAAHEP-accredited programs and anticipating responses from the 50 program directors deemed necessary from our a priori power analysis (sample 2). A total of 201 undergraduate athletic training students (69 men, 132 women) and 43 program directors (22 males, 21 females) completed the instrument. Of the 201 undergraduate athletic training students, 103 (51%) were underclass and 98 (49%) were upper class. Informed consent was achieved through a cover letter and was considered inherent on completion of the instrument. This study was approved by the university's institutional review board.

Instrumentation

Measurement. We chose the GSD to examine the mind styles of the athletic training education undergraduate students and program directors. The GSD is a fixed-sum, self-scoring instrument that focuses on 2 types of styles in adult learners: perception (ie, means of grasping information) and ordering (ie, means of arranging information). Each style is bipolar in nature, ranging from abstractness to concreteness (ie, perception) and sequential to random (ie, ordering) (Figure 1).[4,5] Gregorc used a quaternary design that combines the perception and ordering styles to form 4 channels: CS, AS, AR, and CR.[26,27] The characteristics and preferences of the 4 theoretic styles are defined in Table 1. The GSD requires each participant to rank order 10 columns of 4 words each. A summed, rank score of 27 or greater results in a dominant mind style. It is possible to score more than 27 in more than one mind style, resulting in dual dominance. We used a demographic survey to collect information on sex, academic role, and education level. Operationally defined, education level consisted of underclass (freshmen, sophomore) and upper class (junior, senior) students, whereas academic role consisted of 2 levels (undergraduate students, program directors).

Reported Psychometric Properties. Gregorc[28] provided

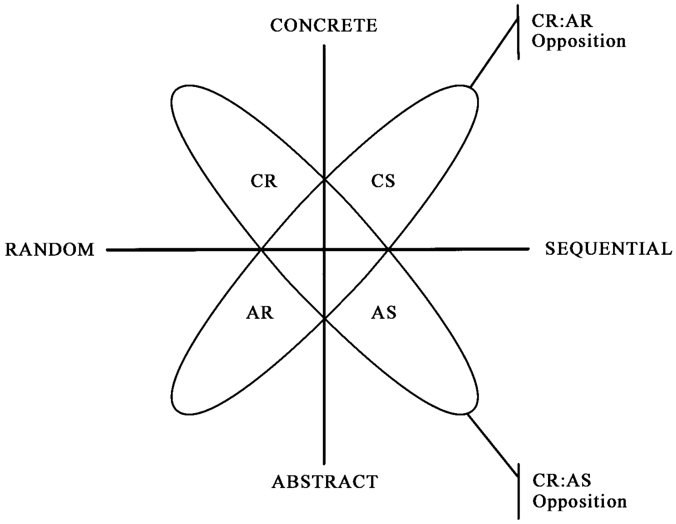

Figure 1. Graphic representation of Gregorc's Mind Styles model. The ovals represent the mind style polar opposition subscales. CR indicates Concrete Random; CS, Concrete Sequential; AR, Abstract Random; AS, Abstract Sequential.

evidence of face validity through 100 interviews, noting that nearly all individuals (89% of 475) found the descriptive words accurate. The second method Gregorc reported was predictive validity, measured by correlation between GSD scores and attribute scores (.70 for CS, .76 for AS, .61 for AR, and .68 for CR). The third method Gregorc described was construct validity, in which 123 subjects were asked to rate descriptions of themselves on a Likert-type scale anchored with 1 (*strongly disagree*) and 5 (*strongly agree*). Of the sample, 29% strongly agreed with their respective descriptions, 57% agreed, 14% were unsure, and there were no responses of disagreement at any level.[28] Additionally, O'Brien[29] recently suggested that the 4 separate scales meet minimal requirements for factor definition. However, Harasym et al[30] proposed that only the bipolar ordering (sequential versus random) channel of the GSD existed, whereas the bipolar perception channel (concrete versus abstract) nullified itself.

Gregorc[28] used 2 approaches to provide evidence for reliability. The first approach involved internal consistency, as measured by the Cronbach α: .92 for CS, .89 for AS, .92 for AR, and .91 for CR. The second approach described stability between first and second test administrations, noting intraclass correlation coefficients of .85 for CS, .87 for AS, .88 for AR, and .87 for CR. More recent reliability analyses conducted by O'Brien[29] and Joniak and Isaksen[31] yielded lower α coefficients (.51 to .64 and .55 to .66, respectively) than those reported by Gregorc.

Procedures

After being randomly sampled in the aforementioned process, program directors of entry-level athletic training programs were contacted via e-mail and invited to participate. To achieve the desired a priori determined sample size, program directors were asked to supply the number of students in their programs. Programs and undergraduate students were added using an equal probability selection method (EPSEM) process until the a priori sample size was achieved. Next, we mailed each program director a packet with the specified number of instruments. The packet provided the program director with instructions for completion and a cover letter to be read aloud as the instruments were administered in a classroom setting. A follow-up e-mail was sent to program directors at 2 and 4 weeks as a reminder. Also, as an incentive to participate, each program director was promised a follow-up report tailored to his or her institution.

Data Analysis

Upon return, all instruments were hand scored and entered into the SPSS software. Descriptive statistics were found for all categorical variables. To determine preference, the rank scores were recoded into a new categorical variable (style type) based on the single highest summed score (ie, dominant style). We calculated a χ^2 goodness-of-fit test statistic to determine if the observed distribution of students' and program directors' mind styles fit the expected distribution. The research design was a single 2 (sex: male or female) $\times$ 2 (education level: underclass or upper class) multivariate analysis of variance (MANOVA) and a single 1-way (academic role: student or program director) MANOVA based on the Wilks λ statistic, using the CS, AS, AR, and CR subscales as the dependent measures. Multivariate and univariate effect sizes were reported as partial η^2. An α level of .05 was set as significant for all main effect analyses. Post hoc analyses were performed using multiple univariate F tests, adjusting familywise α with the Bonferroni correction ($0.05/4 = 0.0125$).

RESULTS

Data Entry and Screening Results

A total of 201 undergraduate athletic training students and 43 program directors completed the GSD. The return rates achieved were 100% and 43%, respectively. Before data analysis, we examined sex, education level, academic role, and the 4 composite Mind Styles scores for accuracy of data entry, missing values, and fit between their distributions and the assumptions of multivariate analysis. A review of the frequen-

Table 1. Characteristics and Preferences of Gregorc's Mind Styles

Style	Characteristics[1,2,15]	Preferences[1,2,15]
Concrete sequential	Methodical, attentive, reliable	Concrete information, "hands-on" experiences, structured learning such as lab worksheets
Abstract sequential	Analytical, logical, serious	Concepts and theory, critical analysis, collaborative learning such as research projects
Abstract random	Perceptive, idealistic, communal	Busy environment, social interaction, unstructured learning such as group discussions
Concrete random	Autonomous, inquisitive, pragmatic	Problem solving, experiments, independent learning such as simulations

Table 2. Intercorrelation Matrix for the 4 Mind Style Preference Subscales (N = 243)

Subscale	Concrete Sequential	Abstract Sequential	Abstract Random	Concrete Random
1. Concrete sequential	NA*	0.122	−0.473†	−0.654†
2. Abstract sequential		NA	−0.595†	−0.392†
3. Abstract random			NA	0.010
4. Concrete random				NA

*NA indicates not applicable.
†$P < .01$ (2 tailed).

cies yielded no missing values for any case in the variables in the analyses. Further inspection, using Mahalanobis distance, identified one case as a multivariate outlier: $\chi^2_4 = 242.02$, $P < .001$. Because this case was an extreme multivariate outlier, we deleted it from subsequent descriptive and inferential analyses, leaving 243 (students = 200, faculty = 43) cases. Further, the tenability of the MANOVA assumptions was tested and maintained.

Observed Psychometric Properties

A principal components factor extraction with varimax rotation performed on the 40 items from the GSD retained 9 factors that cumulatively accounted for 52.84% of the variance. This item-level factor structure resulted in a high level of indeterminancy on the latent variables. Additionally, a similar factor analysis performed at the construct level retained 2 bipolar factors (factor 1: perception, factor 2: ordering) that cumulatively accounted for 81.57% of the variance. This second analysis provided moderate support for the theoretic model at the construct level. As demonstrated in Table 2, an intercorrelation matrix among the 4 mind styles provided modest support for CS-AR opposition ($r = -0.473$) and CR-AS opposition ($r = -0.392$). Reliability analysis yielded standardized α coefficients of .62 (CS), .52 (AS), .56 (AR), and .59 (CR).

Demographics

Students and Program Directors. After we dropped one case, males accounted for 34% (n = 68) of the undergraduate responses and females accounted for the remaining 66% (n = 132) of the sample. The mean age of undergraduate respondents was 20.12 ± 2.02 years, with a range of 18 to 32 years of age. For program directors, males accounted for 51.2% (n = 22) of the responses and females accounted for the remaining 48.8% (n = 21) of the sample. The mean age of program directors was 40.05 ± 9.30 years, with a range of 26 to 63 years. Education level demographics were 51% (n = 102) underclass and 49% (n = 98) upper class students.

Mind Styles. As illustrated in Figure 2, the CS mind style recorded the highest overall percentage (63.4%) of preferred dominance. The percentages of dominance among underclass students, upper class students, and program directors for each preferred mind style are provided in Figure 3. Comparing each mind style across education level and academic role, underclass respondents recorded a 48% (n = 49) preference for CS, upper class respondents recorded a 40.8% (n = 40) preference for CS, and program directors recorded a 58.1% (n = 25) preference for the CS mind style. Comparing mind styles across the sexes, males preferred the CS mind style 55.6% (n = 50) to the other styles. Although females also primarily preferred the CS mind style, 41.8% (n = 64), they additionally preferred the AR mind style 30.1% (n = 46) of the time (Table 3).

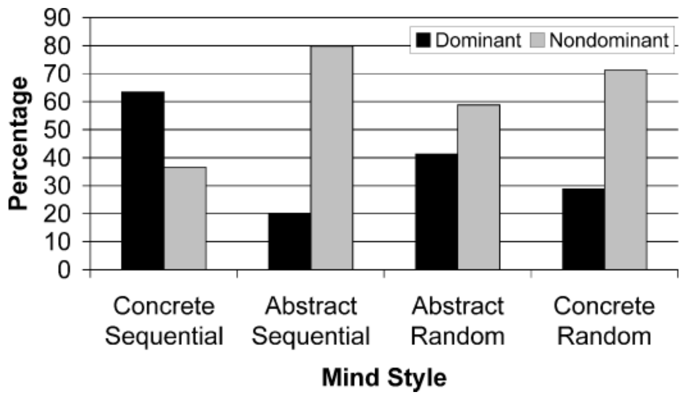

Figure 2. Overall comparison of percentages of dominance versus non-dominance for each mind style. Dominant percentages do not sum to 100 as some individuals were dually dominant.

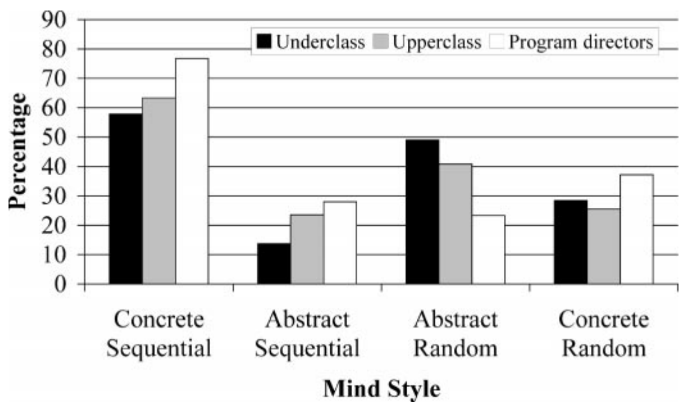

Figure 3. Factorial comparison of education level and mind style type comparison by percentage of dominance. Dominant percentages do not sum to 100 as some individuals were dually dominant.

Hypothesis Testing

Mind Style Preferences. Using the χ^2 criterion, we determined that undergraduate students and program directors proportionately preferred specific mind styles: $\chi^2_3 = 28.72$, $P < .001$ and $\chi^2_3 = 51.48$, $P < .001$, respectively. Evaluation of the standardized residuals indicates that both faculty and students preferred the CS style more than expected. Further analysis of residuals indicated that faculty preferred AS and AR styles less than expected, whereas students also preferred AS styles less than expected (Table 4).

Sex and Education Level Differences. The 2 × 2 between-subjects MANOVA with 4 dependent variables indicated that the linear combination of dependent variables was affected by

Table 3. Descriptive Statistics of Participants (Mean ± SD) (N = 243)

Variable	Concrete Sequential	Abstract Sequential	Abstract Random	Concrete Random
Underclass*	27.53 ± 5.27	23.11 ± 3.51	25.75 ± 1.21	23.62 ± 4.79
Upper class†	28.21 ± 4.55	23.48 ± 4.55	25.03 ± 5.05	23.28 ± 4.78
Program directors‡	30.02 ± 5.36	23.79 ± 5.17	22.40 ± 5.49	23.79 ± 5.90
Undergraduates§	27.86 ± 4.93	23.29 ± 4.05	25.40 ± 4.64	23.45 ± 4.78
Men‖	28.46 ± 4.91	24.19 ± 4.18	24.01 ± 4.77	23.34 ± 5.09
Women¶	27.56 ± 4.93	22.83 ± 3.91	26.11 ± 4.42	23.51 ± 4.62

*n = 102. This row corresponds to the 2 × 2 multiple analysis of variance (MANOVA).
†n = 98. This row corresponds to the 2 × 2 MANOVA.
‡n = 43. This row corresponds to the 1-way MANOVA.
§n = 200. This row corresponds to the 1-way MANOVA.
‖n = 68. This row corresponds to the 2 × 2 MANOVA.
¶n = 132. This row corresponds to the 2 × 2 MANOVA.

Table 4. Preferences of Program Directors and Students for Mind Styles With Standardized Residuals

	Program Directors (n = 43)			Students (n = 200)		
Mind Style	Expected	Observed	Standardized Residual	Expected	Observed	Standardized Residual
Concrete sequential	10.8	25	4.32	50	89	5.52
Abstract sequential	10.8	4	−2.07	50	21	−4.10
Abstract random	10.8	3	−2.37	50	54	.57
Concrete random	10.8	11	.06	50	36	−1.98

sex ($\lambda = .94$, $F_{4,194} = 3.129$, $P < .01$, $\eta^2 = .061$) but not by education level ($P = .310$, $\eta^2 = .024$) or their interaction ($P = .108$, $\eta^2 = .038$). The result reflected a moderate association between sex and the combined dependent variables. Univariate follow-ups indicated that sex affected both the AS ($F_{1,198} = 5.21$, $P < .01$, $\eta^2 = .031$) and AR styles ($F_{1,198} = 9.50$, $P < .01$, $\eta^2 = .054$) but not the CS ($P = .225$, $\eta^2 = .001$) or CR ($P = .813$, $\eta^2 = .000$) styles. The strengths of association for the significant main effects were small and medium, respectively. As indicated in Table 3, male undergraduate athletic training students were more likely (mean = 24.19) to prefer the AS style than were female students (mean = 22.83). Conversely, male undergraduate athletic training students were less likely (mean = 24.01) to prefer the AR style than were female students (mean = 26.11).

Academic Role Differences. A 1-way MANOVA with 4 dependent variables indicated that the linear combination of dependent variables was affected by academic role ($\lambda = .93$, $F_{4,239} = 4.486$, $P < .01$, $\eta^2 = .070$). The result reflected a slightly larger than medium association between academic role and the combined dependent variables. Univariate follow-ups indicated that academic role affected both the CS ($F_{1,241} = 6.57$, $P < .01$, $\eta^2 = .027$) and AR styles ($F_{1,241} = 13.82$, $P < .001$, $\eta^2 = .054$) but not the AS ($P = .486$, $\eta^2 = .002$) or CR ($P = .685$, $\eta^2 = .001$) styles. The strengths of association for the significant main effects were small and medium, respectively. As indicated in Table 3, undergraduate athletic training students were less likely (mean = 27.86) to prefer the CS style than program directors (mean = 30.02). Conversely, undergraduate athletic training students were more likely (mean = 25.40) to prefer the AR style than program directors (mean = 22.40).

DISCUSSION

The GSD psychometric performance with our sample data was imperfect. However, Messick[32] noted that validity is an evolving property and validation a continuing process. Therefore, an instrument is never deemed valid. Rather, the evidence presented merely supports the validity of the data derived from the instrument. In addition, no standard criterion exists that defines a minimum acceptable α or minimum acceptable level of average inter-item correlation.[33] We have presented both positive and negative evidence (both reported and observed) regarding the reliability and validity of the GSD instrument so as to allow the reader to weigh any statements of interpretation we make in our Discussion or Conclusions sections accordingly.

Student and Program Director Preferences

Our primary finding, as evidenced by the χ^2 analyses, was that students and program directors proportionately preferred the CS style over the remaining 3 mind styles more than expected. It is also noteworthy to mention that both students and program directors proportionately preferred the AS style less than expected when compared with the other mind styles. Undergraduate students sampled in this study created the following distribution of styles: 89 (44.5%) were CS, 21 (10.5%) were AS, 54 (27%) were AR, and 36 (18%) were CR. These results support the findings of Gregorc,[28] who reported the CS mind style to be the most commonly preferred, followed by the AS, AR, and CR styles, respectively. However, program directors sampled in this study created a different distribution of styles: 25 (58.1%) were CS, 4 (9.3%) were AS, 3 (7%) were AR, and 11 (25.6%) were CR. Therefore, except for the CS mind style, the pattern of the remaining frequency scores contradicts Gregorc's suggested distribution and provides added theoretic reinforcement to several researchers who rebuke Gregorc's proposed distribution of Mind Style scores.[34–36] Collectively, our findings seemingly indicate that Gregorc's proposed distribution of mind styles in the general population may be flawed when applied to special populations. Nonetheless, some research demonstrates that individuals may tend to select a profession that requires the specific traits of the preferred style innate to that person.[12,35] Therefore, perhaps the unique characteristics of the athletic training profession limit the application of Gregorc's model.

This finding has implications for athletic training students and program directors. First, students' and program directors' preferred mind style was CS. Concrete sequential individuals are task oriented, favoring factual and concrete information that is presented in a highly structured environment and incorporates hands-on activities. Therefore, athletic training educators may promote a more optimal learning environment by using teaching strategies that capitalize on these characteristics, such as simulations and group breakout sessions when instructing in the didactic and clinical settings.

Second, students' and program directors' preferred mind style—CS—coincide. Superficially, this suggests that students' preferred leaning styles and program directors' preferred teaching styles are congruent. However, our study did not distinguish between an educator's preferred mode of learning and his or her actual teaching style. For example, a CS educator may not necessarily teach in a concrete and sequential manner. Consequently, future researchers should attempt to discriminate between teachers' preferred and actual instructional styles.

Sex and Education Level Effects

Several researchers hypothesized that males' and females' learning styles differ developmentally.[34,35,37–39] The effects of sex on styles within athletic training education, regardless of the styles instrument used, are largely unknown. A single known study in the athletic training education literature has examined the effects of sex on student style. Harrelson et al[17] made the first attempt to provide evidence that sex affects an individual's style. They implemented the Preferred Environmental Preference Survey instrument (a measurement of physiologic styles), and its results cannot be compared with those obtained by the GSD. Our study's results revealed that sex affected only the AS and AR styles and that education level did not affect mind styles. Males tended to prefer AS styles more than females, whereas females tended to prefer AR styles more than males (see Table 3). These findings lend support to previous investigations by O'Brien,[29,34] who reported analogous preferred styles findings. In addition, consistent with Hendricson et al,[12] our results suggest that male athletic training students and program directors may possess a greater preference for an analytical, serious, and logical style, whereas female athletic training students and program directors may possess a greater preference for a perceptive, idealistic, and communal style. However, our findings for sex differences diverge from those of Kolb,[39] who noted that 59% of males identified with an abstract style and 59% of females identified with a concrete style, as well as other authors,[40–42] who reported that females prefer concrete types of learning experiences.

The distribution of males (40%) and females (60%) sampled in this study was approximately consistent with the 2002 NATA membership statistics.[43] Therefore, as greater numbers of female students enter the profession, educators may benefit by designing curricula and selecting instructional methods that are sensitive to females' AR learning characteristics. Specific examples may include self-guided techniques, peer teaching, and group activities (discussions and projects) that capitalize on the intuitive and social strengths of the AR mind style.

Academic Role Effects

Our findings indicate that academic role affected both the CS and AR mind styles but not the AS and CR mind styles. Further, undergraduate students were less likely to prefer the CS style and more likely to prefer the AR style than program directors. This supports Reckinger,[44] who reported that students' dominant styles are consistently different from teachers' dominant styles. Wakefield[36] also supported our findings by noting that undergraduate students preferred the AR mind style more than secondary school teachers. Collectively, our results seem to converge with the aforementioned studies, as undergraduate students demonstrated a greater preference for AR styles and program directors demonstrated a greater preference for CS styles. However, these findings appear to diverge from Gregorc's Mind Styles model, which states that academicians should prefer AS styles more often. These results raise the following questions:

1. Is there an institutional effect on students' and program directors' mind style preferences?
2. Do the characteristics inherent to a discipline attract individuals with a high affinity for those characteristics?

We postulate that students may acquire those dominant mind style characteristics that are desired by their chosen profession. This growth would be unopposed if students were not encouraged to develop in other nondominant mind styles. We further suggest that students may be attracted to professions that require characteristics of their dominant mind style. Our claims are supported by Hendricson et al's[12] longitudinal study of dental students' mind styles. Their results yielded stability of styles over time, indicating no institutional effect and supporting the selection of profession theory.

Future Recommendations

As education reform and styles research continue to progress in athletic training, the logical next step for educators must be to conduct research using the rigor of controlled, experimental designs. Some examples include comparing students' educational outcomes, such as Board of Certification examination performance, didactic course grades, and clinical course grades in environments that match and mismatch learning styles. If styles research is to overcome its limitations (eg, nonexperimental designs), educators must use the rigor of experimental controls to causally link the styles paradigm with achievement and other outcome measures. Additionally, researchers must also establish the magnitude of the styles effect on these educational outcomes.

Athletic training is an allied health profession that requires a specific set of physical and mental abilities and seemingly attracts individuals who possess an affinity for the characteristics predicated by the profession. Crocker and Algina[45] stated, ''If a sample of examinees is highly homogeneous on the trait being measured, the reliability estimate will be lower than if the sample were more heterogeneous.'' Therefore, it is possible that athletic trainers, as a whole, are too homogeneous and that sample data from many styles instruments (including the GSD) might be unable to meet the mathematical requirements for reliability. We recommend that future researchers in this and similar areas test and report the observed psychometric performance of the collected sample data so that the causal statements or interpretations made by the author(s) can be weighed accordingly by the reader.

Limitations

Our study used an unbalanced design. When group sizes are greatly different, an unbalanced design can lead to an F that is liberal (ie, rejecting too often) when population variances are unequal.[25] Fortunately, the tenability of all MANOVA assumptions was tested and maintained. A second limitation was our implementation of a correlational ex post facto research design that examined the independent variables' naturally occurring effects after the fact by relating them to outcome or dependent measures. Correlational research designs only establish possible relationships and cannot distinguish between alternative explanations of the findings, but these designs are useful because they suggest possible causal links between variables.[46]

CONCLUSIONS

This study began with a threefold purpose of determining stylistic preference, sex and education level effects, and student and program director effects. Our results revealed the following conclusions:

1. Undergraduate athletic training students and program directors self-reported an overall frequency preference for the CS mind style.
2. Female students clearly differed from male students by preferring the AR style.
3. Education level had no effect on students' or program directors' preferred style.
4. Tested mean differences between undergraduate students and program directors revealed that students preferred the AR style, whereas program directors preferred the CS style.

Overall, research in the area of styles has shown that differences exist in how students prefer to learn.[29,34,35,37,47] Our study provides important additional support for these previous stylistic difference claims while extending them into the allied health discipline of athletic training.

Discernibly, the profession of athletic training must continually evolve to keep pace with public needs and expectations. Similarly, diligent monitoring of instructional practices is also necessary to keep pace with students' needs and expectations. In their text, *Millennials Go to College: Strategies for a New Generation on Campus*, Howe and Strauss[48] discussed the 7 core traits of the 21st-century college student. Two traits, ''specialness'' and ''team orientation,'' are most notable with respect to our findings. First, Howe and Strauss explained ''specialness'' as an artifact of the ''no child left behind'' approach to education that college-aged students have come to expect. Consistent with our findings and the expectations of CS students (see Table 1), the authors explained that the key to reaching these students in the classroom setting is frequent feedback coupled with a highly structured environment.[48] Second, Howe and Strauss explained ''team orientation'' as a result of the high level of interconnectedness offered to this generation through technology. Consistent with our findings and the expectations of AR students (see Table 1), the authors explained that the key to reaching these students in the classroom setting is collaboration in the forms of team teaching and team grading.[48] Whether it is a styles approach or a generational approach to learning differences, the student of the 21st century has unique character traits that will require athletic training educators to rethink contemporary approaches in higher education. Therefore, athletic training educators must continue to make advances in the development of discipline-specific educational theory. Specifically, stylistic differences in how athletic training students perceive information should be paramount to athletic training educators. Therefore, based on the empirical findings of this study, we offer the following suggestions to athletic training educators:

1. Females constitute the majority of certified athletic trainers and students. Therefore, educators should be sensitive to stylistic sex differences and apply pedagogic methods that allow students alternative modes of academic expression and assessment.
2. Educators preferred the CS styles and undergraduate students the AR styles, thereby creating a potentially mismatched educational environment. Therefore, educators must be cognizant of their self-preferred style biases and actively construct opportunities that challenge students to learn in unfamiliar styles.

REFERENCES

1. Sarasin LC. *Learning Style Perspectives: Impact in the Classroom.* Madison, WI: Atwood Publishing; 1999.
2. Curry L. A critique of the research on learning styles. *Educ Leadership.* 1990;48:50–56.
3. Sternberg RJ. *Thinking Styles.* New York, NY: Cambridge University Press; 1997.
4. Butler KA. *Learning and Teaching Style: In Theory and Practice.* Columbia, CT: Learner's Dimension; 1987.
5. Gregorc AF. *An Adult's Guide to Style.* Maynard, MA: Gabriel Systems, Inc; 1982.
6. Gregorc AF, Ward HB. Implications for learning and teaching: a new definition of individual. *Natl Assoc Sec School Principals Bull.* 1977;61:20–23.
7. Barris R, Kielhofner G, Bauer D. Learning preferences, values, and student satisfaction. *J Allied Health.* 1985;14:13–23.
8. Stafford E. Relationship between occupational therapy student learning styles and clinical performance. *Am J Occup Ther.* 1986;40:34–39.
9. Katz N, Heimann N. Learning style preferences of students and practitioners in five health professions. *Occup Ther J Res.* 1991;11:238–244.
10. Sandmire DA, Vroman KG, Sanders R. The influence of learning styles on collaborative performances of allied health students in clinical exercise. *J Allied Health.* 2000;29:143–149.
11. Olson VG, Scanlan CL. Physical therapy students' learning styles and their teaching method and instructional activity preferences. *J Phys Ther Educ.* 2002;16:24–31.
12. Hendricson WD, Berlocher WC, Herbert RJ. A four-year longitudinal study of dental student learning styles. *J Dent Educ.* 1987;51:175–181.
13. Duncan G. An investigation of learning styles of practical and baccalaureate nursing students. *J Nurs Educ.* 1996;35:40–42.
14. Merritt S. Learning style preferences of baccalaureate nursing students. *Nurs Res.* 1983;32:367–372.
15. Ching LS. The influence of distance learning environment on students' field dependence/independence. *J Exp Educ.* 1998;66:149–151.
16. Colucciello ML. Relationships between critical thinking dispositions and learning styles. *J Prof Nurs.* 1999;15:294–301.
17. Harrelson GL, Leaver-Dunn D, Wright KE. An assessment of learning styles among undergraduate athletic training students. *J Athl Train.* 1998;33:50–53.
18. Coker CA. Consistency of learning styles of undergraduate athletic train-

ing students in the traditional classroom versus the clinical setting. *J Athl Train.* 2000;35:441–444.
19. Brower KA, Stemmans CL, Ingersoll CD., Langley DJ. An investigation of undergraduate athletic training students' learning styles and program admission success. *J Athl Train.* 2001;36:130–135.
20. Draper DO. Students' learning styles compared with their performance on the NATA certification exam. *J Athl Train.* 1989;2:234–235,275.
21. Stradley SL, Buckley BD, Kaminski TW, Horodyski MB, Fleming D, Janelle CM. A nationwide learning-style assessment of undergraduate athletic training students in CAAHEP-accredited athletic training programs. *J Athl Train.* 2002;37(4 suppl):S-141–S-146.
22. Coker CA. Learning styles consistency across cognitive and motor settings. *Percept Mot Skills.* 1995;81(3 pt 1):1023–1026.
23. Turocy PS. Overview of athletic training education research publications. *J Athl Train.* 2002;37(4 suppl):S-162–S-167.
24. Kalton G. *Introduction to Survey Sampling.* Newbury Park, CA: Sage Publications; 1983.
25. Stevens J. *Applied Multivariate Statistics for the Social Sciences.* 3rd ed. Mahwah, NJ: Lawrence Erlbaum Assoc; 1996.
26. Gregorc AF. *Gregorc Style Delineator: Development, Technical, and Administration Manual.* Maynard, MA: Gabriel Systems; 1982.
27. Gregorc AF. *Gregorc Style Delineator Research Edition.* Maynard, MA: Gabriel Systems; 1982.
28. Gregorc AF. *Mind Styles Model: Theory, Principles, and Applications.* Maynard, MA: Gabriel Systems; 1982.
29. O'Brien TP. Construct validation of the Gregorc Style Delineator: an application of LISREL 7. *Educ Psychol Meas.* 1990;50:631–636.
30. Harasym PH, Leong EJ, Juschka BB, Lucier GE, Lorscheider FL. Relationship between Myers-Briggs Indicator and Gregorc Style Delineator. *Percept Motor Skills.* 1996;82(3 pt 2):1203–1210.
31. Joniak AJ, Isaksen SG. The Gregorc Style Delineator: internal consistency and its relationship to Kirton's adaptive-innovative distinction. *Educ Psychol Meas.* 1988;48:1043–1049.
32. Messick S. Validity of psychological assessment: validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *Am Psychol.* 1995;50:741–749.
33. Netemeyer RG, Bearden WO, Sharma S. *Scaling Procedures: Issues and Applications.* Thousand Oaks, CA: Sage Publications; 2003.
34. O'Brien TP. Cognitive learning styles and academic achievement in secondary education. *J Res Dev Educ.* 1994;28:11–20.
35. Seidel LE, England EM. Gregorc's cognitive styles: college students' preferences for teaching methods and testing techniques. *Percept Mot Skills.* 1999;88:859–875.
36. Wakefield AP. Learning styles and dispositions in public schools: some implications of preference. *Education.* 1993;113:402–406.
37. Orr B, Park, O, Thompson D, Thompson C. Learning styles of postsecondary students enrolled in vocational technical institutes. *J Ind Teacher Educ.* 1999;36:5–20.
38. Gilligan C. *In a Different Voice.* Cambridge, MA: Harvard University Press; 1982.
39. Kolb DA. *Learning Style Inventory.* Boston, MA: McBer & Co; 1976.
40. Mentkowski M, Strait MJ. *A Longitudinal Study of Student Change in Cognitive Development, Learning Styles, and Generic Abilities in An Outcome-Centered Liberal Arts Curriculum.* Milwaukee, WI: Alverno Productions; 1983.
41. Mentkowski M. The college as an enabling institution. Paper presented at: Annual Meeting of the Association for Moral Education; November 1984; Columbus, OH.
42. Titus TG, Bergandi TA, Shryock M. Adolescent learning styles. *J Res Dev Educ.* 1990;23:165–171.
43. National Athletic Trainers' Association. NATA membership statistics document. Available at: http://www.nata.org/membership/MembStats. Accessed June 7, 2002.
44. Reckinger NR. *Joining Hands: Using Learning and Teaching Styles*: Fullerton, CA: Center for Educational Alternatives, California State University; 1980.
45. Crocker L, Algina J. *Introduction to Classical and Modern Test Theory.* Belmont, CA: Wadsworth Group; 1986.
46. Tuckman BW. *Conducting Educational Research.* 5th ed. New York, NY: Harcourt Brace College Publishers; 1999.
47. Sternberg RJ, Grigorenko EL. Are cognitive styles still in style? *Am Psychol.* 1997;52:700–712.
48. Howe N, Strauss W. *Millennials Go To College: Strategies for a New Generation on Campus.* Washington, DC: American Association of Collegiate Registrars and Admissions Officers; 2003.